



## State of Utah

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<b>From:</b>	Vic Middleton (Issued by S'ean Crawford)		
<b>Date:</b>	September 9, 2004	<b>Pages:</b> 3	
<b>Reference:</b>	Project Number: Project Name: Location: Completion: Project Manager:	04178100 Dept. of Corrections – Promontory Security Fencing State Prison – Draper Utah 90 days after Notice to Proceed – Approx. Dec 17, 2004 Vic Middleton (971-0504)	
<b>Subject:</b>	Addendum No. 1		

The following items are to be considered and included in bidding this project.

### CONTRACT INFORMATION –

1. The Bid date for this project has been moved from Tuesday, September 14, 2004 at 3:00 pm to Tuesday, September 21, 2004 at 3:00 pm.
2. The updated Addendum #1 Drawings and Specifications will be available on September 14, 2004 both on the DFCM web site at <http://dfcm.utah.gov>, and in hardcopy at the DFCM office, 4110 State Office Building.
3. The completion date for this project shall be set 90 days after the issue of the Notice to Proceed. The Notice to Proceed shall be issued within 1 week of the bid opening.
4. Staging for this project shall be as follows;
  - a- Contractor to install the temporary fence as indicated detail A2/AS102.
  - b- Demolition of all areas except the center fence section indicated on detail A2/AS102, approximately 45' -10".
  - c- Complete all construction, then remove temporary fence and install single row of razor wire on existing fence section adjacent to temp fencing area.

## **DEMOLITION – REF. DRAWING AD101**

1. Demolition to include approximately 1,000 feet of 42” high chain link fence, all posts and concrete as indicated on the demolition sheet.
2. Demolition to include the baseball back stop, including all posts and concrete as indicated on the demolition sheet.
3. Demolition to include all asphalt, concrete and landscaping located between the new security fences that are to be covered in weed control mat and gravel.

## **PERIMETER FENCE**

1. The fence shall be 9 gauge fabric only, 11 gauge fabric will not be acceptable. Reference Specification Section 02820.
2. The inside and outside perimeter fences and grade beams shall be identical, a top rail as specified, no center rail, 7 gauge bottom tension wire run through two (2) each 7 gauge stirrups per 10 foot section of fence. The outside fence is to have 3 rows of razor wire, the inside fence is to have 1 row of razor wire. Reference Detail A1/AE201.
3. Gravel between the perimeter fences shall be ¾” minus, 4” deep with a maximum. Reference Specification Section 02720.
4. The grounding ties shall be clamped to the top rail and posts and all connections are to be on the outside face of the fence.
5. Weed Control Mat shall be Dewitt Pro-5 Weed Barrier or Equal. 5 oz. woven, needle punched, polypropylene fabric. Reference Specification Section 02370.

## **MANUAL MAN GATE – ONE (1) EACH – DETAIL B1/AE204**

1. Contractor shall install one 4’-0” x 7’-0” manual swing man gate to the west of the building as located on sheet AS102 and detailed as shown B1/AE204.

## **MOTORIZED MAN GATE FRAME – TWO (2) EACH – DETAIL B1/AE203**

1. Contractor shall install one Bottom Weld Plate 8’-0” x C6 x 8.2. Reference Detail A2/AE203.

## **MANUAL VEHICLE GATE – THREE (3) PAIR – DETAIL A1/AE204**

1. The clear gate opening shall be 14’-0” minimum, two (2) swing gates per opening.
2. The gates shall be all welded construction; the width of the gates shall be determined by the contractor to function in the clear gate opening with the hardware provided by the contractor. The gates shall be the full 12’-0” as the adjacent fence. Contractor shall attach a single row of razor wire to the top of each swing gate.
3. Reference Detail A1/AE204.

### **MOTORIZED VEHICLE GATE – TWO EACH – DETAIL A1/AE202**

1. The Contractor is required to provide detailed fabrication drawings of the motorized gate and assembly from the steel fabrication firm as required in Specification Section 05500. The intent is to define a standard motorized gate for the use at the State Prisons. Electronic CAD files and hardcopy of the fabrication drawings are required to be delivered to DFCM - State of Utah
2. The clear gate opening shall be 14'-0" minimum.
3. The overall gate width shall be 14'-6" minimum.
4. Contractor to install a 6" x 3'-0 x 15'-8" apron on each side of the motorized vehicle gates.

### **BUILDING ROOF BRACKET & RAZOR WIRE INSTALLATION – REF DRAWING AE502**

1. The total perimeter of the roof for this facility is approximately 1130 linear feet.
2. Install approximately 315 linear feet of razor wire with Type 2 Bracket on the north end of the building as indicated Detail A1/AS101, Note # 7.
3. Install approximately 775 linear feet of razor wire with Type 1 Bracket on the rest of the roof perimeter as indicated Detail A1/AS101, Note # 6.
4. There is approximately a 50 feet section of roof perimeter that requires a 4'-0" fence with razor wire attached to the top, the razor wire must be inline with the Razor wire attached to Type 1 Brackets adjacent to it. Reference Diagram B1/AE502.
5. It is the contractor's responsibility to provide wall mounted posts for the roof fence; post design subject to Corrections approval, the design must provide a minimum 2" space from the roof drip edge for maintenance.
6. The contractor shall take care to not damage the existing roof during installation of the roof brackets/posts and razor wire. It shall be the contractor's responsibility to document/photograph any existing damage to the roof prior to construction, and provide a copy of the documentation to the Project Manager. The contractor shall repair all damage not documented after installation is complete.

END OF ADDENDUM #1.

# **DFCM Project # 04178100**

## **Draper Prison Promontory Security Fencing**

### **Specifications Index**

#### **NOTICE TO CONTRACTORS ALL OF THE SPECIFICATIONS HAVE BEEN REVISED SEPTEMBER 14, 2004**

##### **Division 1 – General Requirements**

Reference DFCM RFP

##### **Division 2 – Site Construction**

02210 – Grading  
02220 – Trench & Building Excavation, Backfilling & Compaction  
02720 – Gravel  
02820 – Security Chain Link Fencing & Gates

##### **Division 3 – Concrete**

03300 – Cast-in-place Concrete

##### **Division 4 – NOT USED**

##### **Division 5 – Metals**

05120 – Structural Steel  
05500 – Metal Fabrications

##### **Division 6 to 16 – NOT USED**

## **SECTION 02210 - GRADING**

### **PART 1 - GENERAL**

#### **1.1 WORK INCLUDED**

- A. Preparation
- B. Excavation and filling
- C. Disposal of excess excavated and waste materials
- D. Compaction
- E. Dust and surface water control
- F. Field quality control
- G. Protection

#### **1.2 RELATED WORK**

- A. Section 02220 - Excavating, Backfilling, and Compaction

#### **1.3 QUALITY ASSURANCE**

- A. Comply with federal, state, and local codes and regulations.
- B. All working conditions shall be in accordance with the "Utah Occupational Safety and Health Standard for Construction".
- C. Freezing weather:
  - 1. Unless scheduling requirements of these specifications dictate otherwise, construction of fills during freezing weather shall not be done without approval of the Owner.
  - 2. If placement of earth materials during freezing weather is permitted by the Owner, such permission does not relieve the Contractor of the responsibility to perform the work in accordance with these specifications and at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.1 FILL MATERIALS

#### A. Structural Fill:

1. Shall not be lumpy or frozen.
2. Shall be free from large concentrations of alkali, salt, and petroleum products, all roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Owner is objectionable or deleterious.
3. Shall be "clean" granular soils graded within the following limits.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
4 inch	100
No. 10	50 max.
No. 40	30 max.
No. 200	18 max.

4. A maximum particle size of 2 inches is required of structural fill placed in confined areas.
5. Moisture conditions at the time of placement shall be such the material used will be compactable to required specs.
6. Shall be approved by the Engineer prior to being used on the site of the work.

#### B. Stabilizing structural fill: Mixture of clean coarse gravels and cobbles.

#### C. Non-structural fill:

1. Shall not be lumpy or frozen.
2. Shall be free from large concentrations of alkali, salt, and petroleum products, all roots, sod, limbs, and other vegetative matter, rocks larger than 6 inches in diameter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Owner is objectionable or deleterious.
3. Shall be either cohesive or granular.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Within 10 feet of construction limits, inspect, photograph, and record condition of concrete slabs, structures, landscaping and other features to remain which might be affected by clearing. Mark with paint any existing cracks on concrete along which work will take place, in order to determine after the construction is completed whether such damage was caused by the operations of the Contractor or had occurred previously. Any concrete showing unmarked cracks upon completion of construction will be evidence of damage by the Contractor's forces, and shall be replaced or repaired to the satisfaction of the Owner of the damaged concrete, at the Contractor's own expense.

- B. Obtain necessary permits required for grading.
- C. Establish the location and extent of all underground utilities. Notify necessary utility companies to be present if disturbing ground in the vicinity of utilities. Protect active utility systems adjacent to or uncovered by any excavation during site grading. Maintain, re-route or extend as required, existing ditches, pipelines or utility lines to remain which pass through the construction limits. Pay costs for this work, except those covered by the utility companies. Accurately locate and record abandoned and active utility lines re-routed or extended, on Project Record Documents. Call Blue-Stakes for utility location.
- D. Maintain benchmarks, monuments and other reference points.
- E. Appropriate traffic control devices shall be provided in accordance with federal, state or local regulations to regulate, warn, and guide traffic at the work site.

### 3.2 EXCAVATION AND FILLING

- A. Excavate cut areas to proper elevation. When Structural Fill or other material is to be placed upon exposed surface, take care to prevent disturbing of soils. A smooth-lipped bucket, or other equipment which will produce a smooth, undisturbed surface, shall be used to excavate areas which require placement of Structural Fill or other material on undisturbed natural soil subgrade. Excavation equipment with "teeth" shall not be used as this equipment may disturb the subgrade soils.
- B. Placement of Structural Fill:
  - 1. Structural Fill shall be used to fill below an area which is to be structurally loaded, or which is to support slab-on-grade or pavement, and shall extend from undisturbed native soil to the proper subgrade elevation. Excavated material which meets the specification requirements, including compaction and moisture provisions, may be used as Structural Fill.
  - 2. Under areas to receive structural fill, topsoil shall be completely removed.
  - 3. Prior to placing the structural fill, the subgrade shall be proof-rolled by passing moderately-loaded rubber tire-mounted construction equipment uniformly over the surface continuously at least three times. If excessively soft, loose or disturbed soils are encountered, they shall be removed as directed by Owner, to a maximum depth of two feet, and replaced with COMPACTED GRANULAR STRUCTURAL FILL, compacted to 90% of the maximum laboratory dry density determined by ASTM D-1557 or AASHTO T-180.
  - 4. Prior to placing structural fill, the area to receive the fill shall be prepared as specified in Section 02100.
  - 5. Structural fill should be placed in lifts not exceeding 8 inches in loose thickness.
- C. Placement of Non-Structural Fill:
  - 1. Non-Structural Fill shall be used to fill all areas which do not require Structural Fill. Excavated material which meets the specified gradation, compaction and moisture requirements may be used as Non-Structural Fill.

2. Prior to placing Non-Structural Fill, the area to receive the fill shall be cleared as specified above.
3. Non-Structural fill should be placed in lifts not exceeding 12 inches in loose thickness.

D. Grading Tolerances:

1. Finish areas to within not more than 0.10' above or below required elevations.

E. Uniformly grade areas within construction limits, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

F. Unauthorized excavation:

1. Unauthorized excavation consists of removal of materials beyond indicated elevations or dimensions without specific direction of the Owner.
2. Correct unauthorized excavation as directed, at no cost to the Owner.

G. All material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

H. Fills adjacent to structures shall be placed around the structure in lifts of constant elevation until finish grade is achieved.

### 3.3 DISPOSAL OF EXCESS EXCAVATED AND WASTE MATERIALS

- A. Remove waste material, unacceptable excavated material, surface and sub-surface vegetation, trash and debris and dispose of it off Owner's property in accordance with all applicable laws and ordinances.
- B. Excess excavated material shall be disposed of at the site as planter berms. When quantity shown has been exceeded, dispose of excess excavated material off Owner's property in accordance with all applicable laws and ordinances.

### 3.4 COMPACTION REQUIREMENTS

- A. Each layer of structural fill shall be compacted to at least 90% of the maximum dry density, as determined by the ASTM D-1557 (AASHTO T-180) method of compaction. Non-structural fill shall be compacted to at least 85% of the maximum dry density, as determined by the ASTM D-1557 (AASHTO T-180) method of compaction.
- B. Structural fill placed beneath footings, or to a total thickness in excess of 5 feet, shall be compacted over the full depth of the fill to a least 95 % of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557) method of compaction.
- C. Where layer of soil material to be compacted must be moisture conditioned before compaction, uniformly apply water to surface of layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operation.

- D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

### 3.5 DUST AND SURFACE WATER CONTROL

- A. Dust control measures shall be implemented by application of water to all work areas, storage areas, haul and access roads, or other areas affected by work.
- B. Comply with State of Utah Fugitive Dust Control requirements included at the end of Section 01500.
- C. Provide and operate at least 1 mobile tank sprinkling unit during the contract period.
- D. Surface water shall be controlled to the extent that the areas to receive pavement, walks or slabs are not allowed to become wet from runoff from adjacent areas. Surface water shall be directed away from these areas but not directed toward adjacent property, buildings, or any improvement that may be damaged by water. Surface water shall not be allowed to enter sanitary sewers.

### 3.6 FIELD QUALITY CONTROL

- A. Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.
- B. Testing of compacted fill materials and subgrades will be performed by testing agency employed by the Contractor. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, remove defective work, replace and retest at no cost to Owner.
- C. In each compacted fill layer, testing service shall perform at least one field density test for every 2000 sq. ft. of fill area, but in no case less than 3 tests.

### 3.7 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.
- D. Where settling is measurable or observable in excavated or filled areas during general project warranty period, remove surface (pavement, lawn or other finish), add structural fill material, compact to required specifications, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 02210

## **SECTION 02220 - TRENCH AND BUILDING EXCAVATING, BACKFILLING AND COMPACTION**

### **PART 1 - GENERAL**

#### **1.1 WORK INCLUDED**

- A. Contractor shall provide all materials, labor, equipment, transportation and other items required to perform excavation, backfilling and compaction Work as indicated or as required to accomplish Work of other sections of these specifications. All excavation, backfilling and compaction Work shall be in accordance with applicable regulations and as specified herein.
- B. Excavating, backfilling and compaction includes, but is not limited to the following:
  - 1. Preparation
  - 2. Excavation, backfilling and compaction
  - 3. Dewatering and/or runoff control measures
  - 4. Shoring
  - 5. Clean up, protection, maintenance

#### **1.2 RELATED WORK**

- A. Section 02210 - Grading

#### **1.3 REFERENCES**

- A. The applicable provisions of the latest editions of the References listed below shall govern the Work covered under this Section, unless there is a conflict between said References and the requirements of this Section. In the case of such a conflict, the requirements of this Section shall apply.
- B. Utah Occupational Safety and Health Division (UOSHD).
- C. American Association of State Highway and Transportation Officials (AASHTO):
- D. American Society for Testing and Materials (ASTM)

#### **1.4 SUBMITTALS**

- A. Submit evidence of materials conformance with applicable requirements as well as these specifications.

#### **1.5 QUALITY ASSURANCE**

- A. Comply with federal, state, and local codes and regulations.

- B. All working conditions shall be in accordance with the "Utah Occupational Safety and Health Division", Safe Practices for Excavation & Trenching Operations, latest edition, or other Laws or Regulations which apply.
- C. Utah Department of Transportation requirements:
  - 1. All paving work shall conform to the applicable Utah Department of Transportation standards.
- D. Compaction Testing Frequency:
  - 1. Continuous Footings: 1 test per lift per each 15 lin. ft.
  - 2. Spot FDNS: 1 test per lift per each FDN.
  - 3. Interior Flatwork: 1 test per lift per each 1000 sq. ft.
  - 4. Exterior Flatwork: 1 test per lift per each 2000 sq. ft.
  - 5. Trenches/Curbs/Gutters/Ramps: 1 test per lift per each 40 lin. ft.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Materials suppliers shall provide, upon request, verification of a consistent record of meeting or exceeding materials or performance standards as specified herein.

### 2.2 TRENCH FOUNDATION MATERIALS

- A. All foundation materials shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
- B. Undisturbed soil foundation material:
  - 1. Shall be natural trench bottom soil unless unable to adequately support pipe or structures.
  - 2. Shall not be lumpy or frozen.
- C. Gravel:
  - 1. Shall be hard, durable, broken stone or slag.
  - 2. Shall be graded within the following limits:

<u>Sieve</u>	<u>% Passing</u>
1"	100
3/4"	85-100
1/2"	20-40
No. 4	10-20

## 2.3 BEDDING MATERIALS

### A. Sand Bedding Material:

1. Shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
2. Graded within the following limits:

<u>Sieve</u>	<u>% Passing</u>
3/4"	100
No. 4	80-100
No. 10	30-50
No. 40	10-30
No. 200	0-18

## 2.4 BACKFILL MATERIALS

### A. Granular backfill:

1. Shall be readily compactable and shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
2. Graded within the following limits:

<u>Sieve</u>	<u>% Passing</u>
3 inch	100
No. 10	50 max.
No. 40	30 max.
No. 200	18 max.

3. May be select material from excavation if it will meet all requirements of granular backfill, including compaction requirements as specified for type of surface improvement above trench.

### B. Excavated Soil Backfill Material:

1. Shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the Engineer may be objectionable or deleterious.
2. Shall be select material from excavation, with no particle larger than 3 inches in diameter.
3. Use on-site materials only if specified compaction requirements can be met.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. It shall be the Contractor's sole responsibility to locate all (whether or not shown on the Drawings) existing water, sanitary sewer, storm drain, and gas lines, electrical and telephone conduit and other underground utilities with their existing house service connections, and all other underground structures in order that no damage or loss of service will result from interference with existing lines.
- B. Review all available drawings, notes, and information on the location of these underground lines and structures in determining the location of the existing facilities.
- C. Have an electronic pipe finder on the job at all times and mark all lines on the road ahead of the excavating machine.
- D. Blue Stakes Location Center shall be contacted 48 hours before any excavation is commenced.
- E. Mark with paint any existing cracks on concrete along which work will take place, in order to determine after the construction is completed whether such damage was caused by the operations of the Contractor or had occurred previously. Any concrete showing unmarked cracks upon completion of construction will be evidence of damage by the Contractor's forces, and shall be replaced or repaired to the satisfaction of the Owner of the damaged concrete, at the Contractor's own expense.
- F. All fences removed for excavation shall be returned to their original condition except that damaged portions will be replaced with new fencing at the Contractor's expense.
- G. Obtain all required permits.

### 3.2 METHODS AND PROCEDURES

- A. General Requirements
  - 1. All gas, sanitary sewer, storm drain, water and other pipelines, flumes and ditches of metal, wood or concrete, underground electrical conduits and telephone cable, and all walks, curbs, and other improvements encountered in excavating trenches carefully shall be supported, maintained and protected from injury or interruption of service until backfill is complete and settlement has taken place.
  - 2. If any existing facility is damaged or interrupted, promptly after becoming aware thereof and before performing any Work affected thereby, except in an emergency, identify the owner of such existing facility, and give written notice thereof to that owner and the Owner and Engineer. And indemnify the Owner from any and all damages resulting from damaged facilities.
  - 3. All damage, injury or loss resulting from lack of adequate sheeting, bracing, and shoring shall be the responsibility of the Contractor; and the Contractor shall effect all necessary repairs or reconstruction resulting from such damage.
  - 4. The trenches shall not be backfilled until the utilities systems as installed conform to the requirements of the Drawings and Specifications. Where, in the opinion of the Engineer, damage is likely to result from withdrawing sheeting, the sheeting shall be left in place.

5. Trenches shall be backfilled to the proper surface with material as shown or specified. Trenches improperly backfilled shall be reopened to the depth required for correction, then refilled and compacted as specified, or the condition shall be otherwise corrected as approved.
6. Care shall be exercised so that when backfilling is complete and settlement has taken place, all existing pipes, flumes, ditches, conduits, cables, walks, curbs, and other improvements will be on the same alignment and grade as they were before work commenced.
7. Compaction shall be the responsibility of the Contractor. He shall select the methods to be used and carefully perform the work of backfilling and compaction so as to prevent damage to new or existing piping. Any new or existing piping damaged during the Contractor's work shall be replaced as directed by the Engineer with new piping.

### 3.3 INSTALLATION

#### A. Excavation

1. Excavation for basements, pipe lines, concrete valve boxes, manholes and appurtenant structures shall include the work of removing all earth, sand, gravel, quicksand, stone, loose rock, solid rock, clay, shale, cement, hardpan, boulders, and all other materials necessary to be moved in excavating the trench for the pipe; maintaining the excavation by shoring, bracing, and sheeting or well pointing to prevent the sides of the trench from caving in while pipe laying is in progress; and removing sheeting from the trench after pipe has been laid.
2. Excavation support system shall be suitable for the soil structure, depth of cut, water content of soil, weather conditions, superimposed loads, and vibration. Contractor may select one of the following methods of ensuring the safety of workers in the trench, as approved by the Utah State Industrial Commission or its safety inspectors:
  - a. Sloping sides of excavation to the angle of repose at which the soil will remain safely at rest. Refer to Geotechnical Study, Section 5.2.2.
  - b. Shoring excavation sides by placing sheeting, timber shores, trench jacks, bracing, piles, or other materials to resist pressures surrounding the excavation.
  - c. Using a movable trench box built-up of steel plates and a heavy steel frame of sufficient strength to resist the pressures surrounding the excavation.
3. Trenches shall be of the necessary width for proper laying of pipe. Care shall be taken not to overexcavate. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe along the entire length of the barrel of the pipe.
4. Excavations shall be excavated to the depths shown on the Drawings, including any required allowances for the sewer rock foundation, when required, and for other pipe bedding requirements.
5. Minimum cover over the top of the pipe, including any paving, shall be as follows:
  - a. Water supply piping: 4.0 feet minimum from finish grade.
6. Grading of trenches shall be performed to avoid interference of water and sewer lines with other underground utilities and structures:

- a. Water supply piping: Unless otherwise indicated, trenches shall be graded to avoid high points with the necessity of placing vacuum and relief valves in the water lines.
7. The width of trench, measured at the top of the pipe, shall be as narrow as possible but not wider than 15 inches on each side of sewer or water pipe.
8. Excavation for manholes, concrete valve boxes, and similar structures shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber that may be used to hold and protect the banks.
9. Excess materials shall be hauled away from the construction site or otherwise disposed of by the Contractor as approved by the Engineer.

**B. Backfilling**

1. Materials for trench backfill shall be as shown on the Drawings.
2. Pipe bedding:
  - a. Consists of preparing an acceptable pipe foundation, excavating the pipe groove in the prepared foundation and backfilling from the foundation to 12 inches above the top of the pipe. All piping shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.
  - b. Pipe foundation: Shall consist of natural soil in the bottom of the trench, or a built-up foundation if conditions so warrant. Wherever the trench subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and where groundwater must be drained, the trench shall be excavated below the bottom of the pipe to such depth as may be necessary, and this additional excavation filled with clean, compacted sewer rock.
  - c. A pipe groove shall be excavated in the pipe foundation to receive the bottom quadrant of the pipe so that the installed pipe will be true to line and grade. Bell holes shall be dug after the trench bottom has been graded. Bell holes shall be excavated so that only the barrel of the pipe bears on the pipe foundation.
  - d. Pipe bedding from pipe foundation to 12 inches above top of pipe: Materials shall be deposited and compacted in layers not to exceed 8 inches in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Materials used shall be as shown in the Typical Trench Section in the Drawings and as specified in Part 2.
3. Each lift shall be evenly spread and moistened or dried by disk harrowing or other means so that the required density will be produced.
4. Backfill around valves with Granular Backfill Material.
5. Backfill of basement "below grade walls" shall be with a free draining granular material as described in the Geotechnical Study, Section 5.2.3, paragraph 3.

**C. Compaction**

1. Backfill Compaction Requirements:
  - a. Under pavements, floors, or other surface improvements, the average density shall be 95% of laboratory maximum density with no individual test lower than 92% of the laboratory maximum density, as determined by AASHTO Designation T-180 (ASTM D-1557).
  - b. In shoulders and other unimproved areas, the average density shall be 90% of laboratory maximum density with no individual test lower than 86% of the laboratory maximum density, as determined by AASHTO Designation T-180 (ASTM D-1557).
2. Compaction shall be performed in strict accordance with the manufacturer's recommendations for each type of pipe.
3. Mechanical compaction: Shall be accomplished by the use of sheeps-foot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers of a size and type necessary to achieve the required degree of compaction.

D. Dewatering

1. The Contractor shall do all pumping, shall build all drains and do all the work necessary to keep the trench and pipes free from water during the progress of the work.
2. In wet trenches, a channel shall be kept open along the side of the pipe for conducting the water to a sump hole, from which it shall be pumped out of the trench. No water shall be allowed to enter the pipe.

3.4 PROTECTION

- A. Provide barricades and restrict access as appropriate to prevent damage to Work in place.
- B. Contractor shall be responsible for protection of Work in place against displacement, damage, or loss until Owner's acceptance. Any work and subsequently damaged, lost or displaced shall be repaired or replaced to the Owner's satisfaction at no additional cost.

3.5 CLEANING

- A. Thoroughly clean, rake, wash, flush or sweep as required to clean adjacent improvements of materials covered as part of this Work prior to submitting for Owner's acceptance.
- B. Contractor shall provide all labor, equipment, materials and other items as required to perform clean up as required by the Owner, adjacent property owners and other jurisdictions.
- C. Finish grading of areas affected by this Work shall be required as part of clean up.
- D. The roadway including shoulders, slopes, ditches, and borrow pits shall be smoothly trimmed, and shaped by machinery, or other satisfactory methods, to the lines, grades and cross-sections,

as established, and shall be so maintained until accepted. Any surplus material not suitable for spreading along the road to widen the existing shoulder or raise the grade shall be disposed of as specified above.

### 3.6 TESTING

- A. The Contractor shall employ a testing laboratory to perform field and laboratory density tests, except that the Contractor shall make such additional tests, at his expense, as deemed necessary by him to assure that the work of compaction is performed properly, determine any adjustments in compacting equipment, thickness of layers, moisture content and compactive effort or other means necessary to obtain the specified minimum relative density. Provide access to the work and all men and machinery necessary to aid the testing laboratory personnel in performing field density tests or taking samples for laboratory tests. In general, tests and samples shall be made as the work proceeds.
- B. Have testing laboratory perform maximum density tests on materials to be compacted from samples submitted by Contractor taken from locations selected by the Engineer.
- C. Have testing laboratory perform field density tests of compacted backfill materials. The approximate location and number of such tests shall be as shown on the drawings, as described in the Bid Form, or as selected by the Engineer. Field density tests shall be taken as follows:
  - 1. In planted or unimproved areas:
    - a. 18" above the top of the pipe
    - b. Finished grade
  - 2. In streets, roads, parking lots or other paved areas:
    - a. 18" above the top of the pipe
    - b. 24" to 36" below the gravel road base
    - c. Gravel road base subgrade
    - d. Top of gravel road base
    - e. Top of bituminous surface course
- D. Copies of test results prepared by the testing laboratory shall be transmitted to the Contractor at the same time they are transmitted to the Engineer.
- E. Successful performance of compaction at the location of the field density test shall not relieve the Contractor of his responsibility to meet the specified density requirements for the complete project.

END OF SECTION 02220

## SECTION 02720 – GRAVEL

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Subgrade preparation to lines and grades shown on the plan or specified.
- B. Place, grade and compact sub-base.
- C. Install weed control matt.
- D. Place and grade gravel covering.

#### 1.2 RELATED WORK

- A. Section 02210 - Grading
- B. Section 02220 - Excavating, Backfilling and Compaction

#### 1.3 REFERENCES

- A. American Society for Testing Materials (ASTM).

### PART 2 - PRODUCTS

#### 2.1 GRAVEL BETWEEN SECURITY FENCES

- A. Shall 3/4" minus, and shall be unwashed, hard, durable, angular pit run gravel or crushed natural stone.
- B. Shall be free from shale, silt, clay, loam, friable or soluble materials.
- C. Shall be free from noticeable concentrations of alkali, salt, and petroleum products, all roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that, in the opinion of the Corrections, is objectionable or deleterious.

### PART 3 - EXECUTION

#### 3.1 PREPARATION OF SUBGRADE BETWEEN FENCES

- A. Prior to placing weed control matt and gravel between fences, the subgrade shall be scarified to a depth of not less than 2", graded and compacted to no more than 2" variation.

- B. Ensure subgrade is to required lines and elevations.

### 3.2 WEED CONTROL MATT / BARRIER

- A. Weed control matt / barrier shall be DeWITT PRO 5 Weed Barrier, 5 oz. Woven needle-punched material, or approved equal.

### 3.3 PLACEMENT AND GRADING OF GRAVEL

- A. Gravel covering shall be placed with a minimum of 4" coverage over the weed control matt / barrier.
- B. There shall be no more than 2" of variation of the final gravel grade.

END OF SECTION 02720

## **SECTION 02820 – SECURITY CHAIN LINK FENCING AND GATES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide chain link fences and gates as complete units controlled by a single contractor including excavation, backfill, concrete, necessary erection accessories, hardware, fittings, and fastenings.
- B. Related Sections include the following:
  - 1. Division 2 Section 02210 Grading.
  - 2. Division 2 Section 02220 Trench & Building Excavation, Backfilling & Compaction.
  - 3. Division 3 Section "Cast-in-place Concrete" for concrete post footings and grade beams.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data, and installation instructions for metal fencing and gates, design mix for concrete.
- B. Shop Drawings: Comply with all requirements and indicate the following: layout, arrangement, dimensions, materials, finishes; fabrication, assembly and erection details; sizes of all members; fastenings, supports, and anchors; patterns, clearances, and all necessary connections to work of other trades. Provide shop drawings showing complete assembly for combinations of manufacturer's items as detailed. Coordinate hardware for each gate, verify lock mounting with detention equipment supplier, and show mounting height, configuration.
- C. Shop drawings that are non-conforming to the above will be rejected.
- D. Samples: Three 12" long samples of barbed wire and barbed tape shall be submitted to the Utah Department of Corrections for approval.
- E. Submit framework performance test: Pipe and tubing shall meet the following performance criteria when subjected to salt spray testing in accordance with ASTM B/17: Exterior- 1,000 hours with maximum 5% red rust Interior- 650 hours with maximum 5% red rust.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type or class of fence material of the same brand from the same manufacturer.

- B. Applicable Reference Standards: Comply with the following, unless more stringent provisions are indicated:
1. ASTM A-90, Test method for weight of coating on zinc-coated (galvanized) iron or steel articles.
  2. ASTM A-153, Zinc coating (hot dip) on iron and steel hardware. C. ASTM A-392, zinc-coated steel chain link fence fabric.
  3. ASTM A-446, Steel sheet, zinc-coated (galvanized) by the hot-dip process, structural (physical) quality.
  4. ASTM A-569, Steel, Sheet, and Strip, Carbon (0.15 maximum), Hot-rolled, Commercial quality.
  5. ASTM A-824, Metallic coated steel marcelled tension wire for use with chain link fence.
  6. ASTM B-117, Method of salt spray (fog) testing. H. ASTM F-626, Fence fittings.
  7. ASTM F-669, Strength requirements of metal posts and rails for industrial chain link fence.
  8. ASTM A-780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  9. ASTM F-900-03, Standard Specification for Industrial and Commercial Swing Gates.
  10. ASTM F-1043, Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
  11. ASTM F-1083, Pipe, Steel, Hot-dipped zinc coated (galvanized) welded for fence structures.
  12. Chain Link Fence Manufacturers Institute (CLFMI) Product Manual.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Load products in such a manner that they may be transported and unloaded without being damaged. Deliver products to project site in cartons or crated to provide protection during transit and project site storage. Time delivery to avoid delaying other trades whose work is dependent on this work. Coordinate delivery timing with Contractor.
- B. Storage: Place all products in storage location as directed. Do not store products on or in a manner that might cause distortion or damage to the products or the supporting structures. Repair or replace damaged products as directed.
- C. Markings: Tag all products with markings, which show proper installation locations.
- D. Defective Products: Items found to be defective either through manufacturing, transit damage, field installation, etc. shall be replaced within a three week period. Special shipment and manufacturing arrangements shall be arranged to accomplish this requirement.

#### 1.6 WARRANTY

- A. Contractor to provide and service a warranty against defects in all materials for ten (10) years after completion of project.

#### 1.7 CLEANING

- A. Upon Completion of the fence installation, clean up all waste material and debris resulting from the construction.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. Steel Chain Link Fence Manufacturers: Subject to compliance with requirements, manufacturer's offering steel chain link fencing products which may be incorporated in the work included are limited to the following:
  - 1. American Security Fence Co.
  - 2. American Chain Link Fence Co.
  - 3. Allied Tube and Conduit Fence Division
  - 4. Anchor Fence, Inc.
  - 5. United States Steel, Cyclone Fence Div.
  - 6. Merchant Metals, Inc.
- B. Razor Wire Manufacturers: Subject to compliance with requirements, manufacturer's offering Barbed Tape Obstacle products which may be incorporated in the work included are limited to the following:
  - 1. American Security Fence Co.
  - 2. Micheal Industries
  - 3. Allied Tube & Conduit

### 2.2 MATERIALS

- A. Steel Fencing
  - 1. Fabric:
    - a. As required 9 ga. finished size steel wires, 2" mesh, with both top and bottom salvages twisted and barbed.
    - b. Furnish one-piece fabric widths for fencing up to and including 12' high.
    - c. Fabric finish, galvanized, ASTM A392, Class 11, with not less than 2.0 oz. zinc per sq. ft. of actual surface covered according to ASTM A-90. The zinc used for the coating shall conform with ASTM B-6. Poly vinyl Chloride (PVC) coated fabric may not be used as a alternate to galvanized fabric.
  - 2. Framework: Posts, Rails and Braces
    - a. Standard weight (Schedule 40) in conformance to ASTM F- 1083, minimum yield strength of 25,000 psi and galvanized with a zinc coating not less than 1.8 ounces per square foot.
    - b. High strength pipe with steel complying with ASTM A-446 (Grade D) or ASTM A-569, minimum yield strength of 50,000 psi and an exterior galvanized with zinc not less than 0.9 ounces per square foot a chromate conversion coating and a minimum 0.3 mils of clear acrylic. Interior coating shall be galvanized with zinc not less than 0.9 ounces per square foot (min. of 1.53 mils thick) or a minimum 0.6 mils thick zinc rich paint with a 91% load per square foot.
  - 3. Hardware and Accessories: Provide galvanized products as required for a complete installation.
  - 4. End, Corner and Pull Posts: Weights (+/- 5%) Minimum sizes as follows:

- a. For fence heights 6 ft. up to and including 8 ft: 2.875" o.d. x 5.79 lbf/ft steel pipe (schedule 40) or 2.875" o.d. x 4.64 lbf/ft steel pipe (high strength) .Maximum distance of 250 ft. between pull posts.
  - b. For fence heights 9 ft up to and including 12 ft: 4" o.d. x 9.11 lbf/ft steel pipe (schedule 40) or 4" o.d. x 6.56 lbf/ft steel pipe (high strength) .Maximum distance of 250 ft. between pull posts.
  - c. Engineering calculations should be used to determine requirements for fence fabric heights over 12 ft or under ice, snow and high wind loads.
5. Line Posts: Weights (+/- 5%) ; Minimum sizes as follows:
  - a. For fence heights 6 ft. up to and including 8 ft: 2.375" o.d. x 3.65 lb/ft steel pipe (schedule 40) or 2.375" o.d. x 3.12 lbf/ft steel pipe (high strength).maximum distance of 10 ft. o.c., unless otherwise indicated.
  - b. For fence heights 9 ft up to and including 12 ft: 2.875" o.d. x 5.79 lbf/ft steel pipe (schedule 40) or 2.875" o.d. x 4.64 lb/ft steel pipe (high strength) .Maximum distance of 10 ft. o.c. unless otherwise indicated.
  - c. Engineering calculations should be used to determine requirements for fence fabric heights over 12 ft or under ice, snow and high wind loads.
  - d. Posts to be vertical within four degrees (4°) in two planes.)
6. Top, Intermediate, Bottom Brace Rails:
  - a. Braces and rails for all fence heights shall be 1.66" x 2.27 lb/ft steel pipe (schedule 40) or 1.66" x 1.82 lbf/ft steel pipe (high strength).
  - b. Rails will be required to use expansion type couplings approximately 6" long, for each joint on continuous runs.
  - c. Provide means for attaching rails and braces securely to all line, gate, corner, pull and end posts.
7. Gate Posts for swing gates shall be as shown on drawings.
8. Post Brace Assembly: -Manufacturer's standard adjustable brace at end and gateposts and at both sides of corner and pull posts. Use same material as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tighteners.
9. Post Tops: Weather-tight closure cap (for tubular posts), one cap for each post, secured to post with tack welds.
10. Tension Wire: Shall be 7 ga. 0.177 inch minimum diameter crimped coil or marcelled spring hard-tempered carbon steel wire with a zinc coating of 1.2 ounces per sq. ft. of surface or greater.
11. Barbed Barrier: Barbed Barrier: Double coil "Maze" 30" and 24" diameter (concertina) style barbed tape shall have adjacent loops of each coil alternately clipped 3 times around the circumference of each loop. The clip shall be 0.065" x 0.375" stainless steel capable of withstanding a pull load of 150 lbs. Each coil shall consist of 3 loops with the spacing between attachment points equal to 16" +/- 2". The length of the extended coil shall be 20 feet. The barbed tape shall be fabricated from 430 stainless steel, which shall be permanently cold-clenched 230 degrees around a Class III galvanized (0.80 ounce zinc per square foot) 0.098" diameter core wire. The barbed tape shall contain a cut-resistant flange. The stainless steel strip shall be 1" wide before roll-forming and shall be .025" thick with clusters of four needle sharp barbs on 4" centers. Barbs shall have a minimum length of 1.2". Barbs shall be alternately offset from the tape centerline. 15" min. - .45" max.
12. Field Applied Galvanizing Repair Paint: Welded areas shall be repaired per ASTM A-780, Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings, Annex A2, using zinc-rich paints which contain a minimum of 94% zinc dust by weight.

13. Stretcher Bars: One piece lengths equal to full height of fabric, with minimum cross section of 1/4" x 3/4". Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post.
14. Stretcher Bar Bands: Space not over 15" o.c., to secure stretcher bars to end, corner, pull, and gate posts.
15. Gates:
  - a. Fabricate swing gate perimeter frames of pipe diameters as specified. Metal and finish to match framework. Provide horizontal and vertical members to ensure proper gate operation and for attachment for fabric, hardware and accessories. Space so that frame members are not more than 8 ft. apart.
  - b. Assemble gate frames by welding for rigid connections. Use same fabric as for fence type. Install fabric with stretcher bars at vertical edges and tie wires at top and bottom edges. Attach stretcher to gate frame at not more than 15" o.c.
  - c. Attach hardware to provide security against removal or breakage. Install diagonal cross bracing consisting of 3/8" diameter adjustable lengths truss rods on gates to ensure frame rigidity without sag or twist.
16. Gate Hardware: Finish the following malleable iron hardware and accessories for each gate:
  - a. Hinges: Size, quantity, and material to suit swing gate size, non/lift-off type, offset to permit 180 degree gate opening. Provide minimum of 1-1/2 pair of hinges for each leaf.
  - b. Single Gate Latch: Gate latch shall be capable of retaining the gate in a closed position and shall have provision for a padlock.
  - c. Double Gate Latch: Gate latch shall be a drop rod or plunger bar arranged to engage the gate stop. Locking devices shall be constructed so that the center drop rod or plunger bar cannot be raised when the gate is locked. The latching devices shall have provision for a padlock.
  - d. Gate Stops: Gate stops shall be provided for all double gates.
  - e. Keepers shall be provided for each gate leaf over 5 ft. (1.5m wide).
17. Wire Ties: For tying fabric to all line, gate, end, corner and pull posts, use wire ties space 12" o.c. For tying fabric to all rails and braces, use wire ties spaced 16" o.c. For tying fabric to tension wire, use 11 ga. hog rings spaced 12" o.c. All galvanized. Tie wire min. 9 ga. galvanized steel.
18. Gate Latches: stops, and keepers shall be provided as appropriate for all gates. Latches shall have a plunger-bar or center drop rod of full gate height arranged to engage the center stop, except that for single leaf gates, gate latch shall be as detailed. Latches shall be arranged for locking with specified locking hardware.
19. Locks: furnished by Owner, N.I.C..

### PART 3 - INSTALLATION

#### A. Post Footings:

1. Drill holes for posts of diameters and spacing shown, in firm undisturbed or compacted soil.
2. Unless otherwise indicated, excavate hole depths approximately 3" lower than post bottom.

#### B. Setting Posts:

1. Center and align posts in hole 3" above bottom of excavation. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. When encountering rock; drill rock to required depth and set post in concrete grout.
- C. Bottom-Tension Wire must be stretched from end to end of each stretch of fence and positioned at a height that will enable it to be fastened to the fabric within bottom 3 in. (75mm) of the fabric and through each stirrup set in the concrete grade beam and shall be tied to each post with a tie wire. . The tension wire should be taut and free of sag.
- D. Top Rail: must be supported at each post so that a continuous brace from end to end of each stretch of fence is formed. Securely fasten the top rail to the terminal posts and join with sleeves or coupling to allow for expansion and contraction.
- E. Center Rail: Provide rails where shown on drawings and/or required by specification. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- F. Brace Assemblies:
  1. Install braces so posts are plumb when diagonal rod is under proper tension.
- G. Fabric:
  1. Pull fabric taut free from waves and buckles. Tie to posts and rails:
  2. Install fabric on security side (inside facing buildings) of fence, and anchor to framework so that fabric remains in tension after pulling force is released. Tension fabric to comply with industry standards for security fencing.
- H. Stretcher Bars:
  1. Thread through or clamp to fabric 4" o.c., and secure to posts with metal bands spaced 15" o.c.
- I. Barbed Barrier:
  1. Extend the (30" & 24") double coil Maze approximately 20 feet in length and secure as a security ground barrier. The Maze shall be stretched out with uniform coil spacings of 16" +/- 2" on center and attached to the fence fabric located at the base of the fence and up the fence fabric. Stainless steel 12-1/2 ga. hog rings shall be used to securely attach all adjacent rows together approximately 32" to 36" on center, both vertically and horizontally throughout the ground barrier stack. The bottom row of wire-reinforced barbed tape installed as a ground barrier shall be anchored at 10 ft on center with rebar ground stakes. T anchor shall be driven into the ground approximately 18" and hooked around the coil loops resting on the ground, then tie off ground stake to barbed tape loop with the stainless steel wire ties.
  2. Splicing successive rolls of bar bed tape shall be continued by aligning the attachment clips and connecting the splicing tails located at each end of the rolls. Overlap the splicing tails and attach the barbed clusters together with stainless steel hog rings in a manner to prevent one barb slipping past the other. Complete the splice for the 30" barbed tape with hog rings evenly spaced to the end splice where clips would have been if manufactured into a continuous roll.
- J. Gates:

1. Brace gate posts diagonally to adjacent line posts to insure stability. Modify gates and posts as required to receive hardware. Hang gates and adjust all hardware so that gates operate satisfactorily from open or closed position. The maximum clearance between the bottom of the gate in closed position and finished grade shall be 3 in.
- K. Tie Wires:
1. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend wire to minimize hazard to persons or clothing.
- L. Fasteners:
1. Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- M. Wire Stirrups:
1. Install 7 ga. Galvanized wire stirrups, 2 each between posts equally spaced in the grade beam a minimum of 6 inches in depth with a 2" long bend on each leg.
- N. Concrete Grade Beam:
1. A concrete Grade beam shall be constructed on both fences that measures 8" wide, 36" deep and runs continuously for the entire distance of the fence.

END OF SECTION 02820

## **SECTION 03300 - CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section specifies normal weight and light weight cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
- B. Related Sections include the following:
  - 1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
  - 2. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.

#### **1.3 SUBMITTALS**

- A. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- B. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- B. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
  - 1. ACI 301, "Specification for Structural Concrete."
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: (Exposed to view) Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: (Not exposed to view) Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than **1 inch (25 mm)** to the plane of the exposed concrete surface.

### 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (Grade 420)**, deformed.
- B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

### 2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

### 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.

- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
  - 1. Nominal Maximum Aggregate Size: 1 inch (25 mm).
  - 2. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).
- C. Lightweight Aggregate: ASTM C 330.
  - 1. Nominal Maximum Aggregate Size: 3/8 inch (10 mm).
- D. Water: Potable and complying with ASTM C 94.

## 2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.

## 2.6 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
  - 1. Profile: Flat, dumbbell with center bulb.

## 2.7 CURING MATERIALS

- A. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.8 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.9 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

## CAST-IN-PLACE CONCRETE

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1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
  2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
  2. Maximum Slump: 5 inches (125 mm).
  3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 2- to 4-inch (50- to 100-mm) slump.
- D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
  2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
  3. Maximum Slump: 4 inches (100 mm).
- E. Suspended Slabs: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
  2. Maximum Slump: 4 inches (100 mm).
- F. Suspended Slabs: Proportion lightweight structural concrete mix as follows:
1. Compressive Strength (28 Days): 3000 psi (20.7 MPa).
  2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft. (1762 kg/cu. m) plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
  3. Maximum Slump: 5 inches (125 mm).
- G. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
- H. Maximum Water-Cementitious Materials Ratio: 0.45.
- I. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

## 2.10 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

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1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  1. Class A, 1/8 inch (3 mm).
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
  1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor bolts, imbeds and dowels, accurately located, to elevations required.

### 3.3 REMOVING AND REUSING FORMS

- A. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
  - 1. At least 70 percent of 28-day design compressive strength.
  - 2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
  - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
  - 2. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch (3 mm)**. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3-mm-)** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
  - 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.6 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

### 3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

- D. Deposit concrete in forms in horizontal layers no deeper than **24 inches (600 mm)** and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
  2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least **6 inches (150 mm)** into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below **40 deg F (4.4 deg C)**, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than **50 deg F (10 deg C)** and not more than **80 deg F (27 deg C)** at point of placement.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below **90 deg F (32 deg C)** at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: (Not exposed to view) As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: (Exposed to view) As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding **1/8 inch (3 mm)** in height.
  - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
- C. Rubbed Finish: Apply the following to smooth-formed finished concrete:
  - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
  - 1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.
- C. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system

2. Finish and measure surface so gap at any point between concrete surface and an unlevelled freestanding **10-foot- (3.05-m-)** long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:

- a. **3/16 inch (4.8 mm).**

- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces *with non-slip aggregate finish*.

### 3.11 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
  1. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  6. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

### 3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  - 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  - 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  - 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  - 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
    - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
  - 7. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and two at 28 days. Reserve one specimen.
    - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project

identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION 03300

## **SECTION 05120 - STRUCTURAL STEEL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes structural steel.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.

#### **1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings detailing fabrication of structural steel components.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
  - 3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
  - 4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

- C. Comply with applicable provisions of the following specifications and documents (See structural notes for specific exclusions):
1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
  2. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."
  3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
  4. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
  5. AISC's "Seismic Provisions for Structural Steel Buildings."
  6. **ASTM A 6 (ASTM A 6M)** "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
  7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
  2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

#### 1.6 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Structural Steel Shapes, Plates, and Bars: As follows:
  - 1. Carbon Steel: **ASTM A 36 (ASTM A 36M)**.
  - 2. High-Strength, Low-Alloy Columbium-Vanadium Steel: **ASTM A 572 (ASTM A 572M)**, Grade 50.
- B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.
- C. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.
- D. Anchor Rods, Bolts, Nuts, and Washers: As follows:
  - 1. Unheaded Rods: **ASTM A 307**.
  - 2. Unheaded Rods: **ASTM A 449**.
  - 3. Headed Bolts: **ASTM A 325 (ASTM A 325M)**, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
  - 4. Washers: **ASTM A 36 (ASTM A 36M)**.
- E. Nonhigh-Strength Bolts, Nuts, and Washers: **ASTM A 307, Grade A (ASTM F 568, Property Class 4.6)**; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
  - 1. Finish: Plain, uncoated.
- F. High-Strength Bolts, Nuts, and Washers: **ASTM A 325 (ASTM A 325M)**, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
  - 1. Finish: Plain, uncoated.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325.
- G. Welding Electrodes: Comply with AWS requirements.

### 2.2 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

## 2.4 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
  - 1. Camber structural steel members where indicated.
  - 2. Identify high-strength structural steel according to **ASTM A 6 (ASTM A 6M)** and maintain markings until steel has been erected.
  - 3. Mark and match-mark materials for field assembly.
  - 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
  - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
  - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded.
- C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.
- E. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.
  - 1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
  - 2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

## 2.5 SHOP CONNECTIONS

- A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
- B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
  - 2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds **1/2 inch (13 mm)** and larger. Grind flush butt welds. Dress exposed welds.

## 2.6 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches (50 mm)**.
  - 2. Surfaces to be field welded.
  - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications:
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than **1.5 mils (0.038 mm)**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
  - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

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1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
  2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
  3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
    - a. Comply with manufacturer's instructions for proprietary grout materials.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
  2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Finish sections thermally cut during erection equal to a sheared appearance.
- I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- 3.4 FIELD CONNECTIONS
- A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1. Bolts: **ASTM A 325 (ASTM A 325M)** high-strength bolts, unless otherwise indicated.
  2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
- B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

### 3.5 FIELD QUALITY CONTROL

- A. General Contractor will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
  1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
  1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
  4. Ultrasonic Inspection: ASTM E 164.
- F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
  1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
  2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

### 3.6 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05120

## **SECTION 05500 - METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:

1. Steel ladders.
2. Steel ship's ladders.
3. Loose bearing and leveling plates.
4. Loose steel lintels.
5. Shelf angles.
6. Support angles for elevator door sills.
7. Elevator machine beams.
8. Steel framing and supports for overhead doors.
9. Steel framing and supports for operable partitions.
10. Steel framing and supports for countertops.
11. Steel framing and supports for mechanical and electrical equipment.
12. Metal angle corner guards.
13. Metal edgings.
14. Loading-dock edge angles.
15. Pipe bollards.
16. Air well grate cover.

- B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 5 Section "Metal Stairs" for metal-framed stairs with metal pan, metal plate, or grating treads.
3. Division 5 Section "Metal Stairs" for metal pipe and tube handrails and railings.
4. Division 5 Section "Ornamental Handrails and Railings" for ornamental metal handrails and railings.

#### **1.3 SUBMITTALS**

- A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
  1. Provide templates for anchors and bolts specified for installation under other Sections.

- B. Samples for Verification: For each type and finish of extruded nosing and tread.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
  - 3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

#### 1.6 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### PART 2 - PRODUCTS

#### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

#### 2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

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- B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- D. Malleable-Iron Castings: **ASTM A 47, Grade 32510** (**ASTM A 47M, Grade 22010**).
- E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.3 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

## 2.4 FASTENERS

- A. Bolts and Nuts: Regular hexagon-head bolts, **ASTM A 307, Grade A** (**ASTM F 568M, Property Class 4.6**); with hex nuts, **ASTM A 563** (**ASTM A 563M**); and, where indicated, flat washers.
- B. Anchor Bolts: ASTM F 1554, Grade 36.
- C. Machine Screws: **ASME B18.6.3** (**ASME B18.6.7M**).
- D. Lag Bolts: **ASME B18.2.1** (**ASME B18.2.3.8M**).
- E. Plain Washers: Round, carbon steel, **ASME B18.22.1** (**ASME B18.22M**).
- F. Lock Washers: Helical, spring type, carbon steel, **ASME B18.21.1** (**ASME B18.21.2M**).
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
- H. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

## 2.5 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- I. Remove sharp or rough areas on exposed traffic surfaces.
- J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

## 2.7 STEEL LADDERS

- A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
  - 1. Comply with ANSI A14.3, unless otherwise indicated.
  - 2. For elevator pit ladders, comply with ASME A17.1.
- B. Siderails: Continuous, 1/2-by-2-1/2-inch (12-by-64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.
- C. Bar Rungs: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.
- D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
- E. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
- F. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- G. Galvanize ladders, including brackets and fasteners, in the following locations:
  - 1. Exterior.

## 2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

## 2.9 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.
- C. Galvanize shelf angles to be installed in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.10 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- C. Fabricate supports for operable partitions as follows:
  - 1. Continuous steel shapes of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

## 2.11 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate steel door frames from structural shapes and bars of size and to dimensions indicated, fully welded together, with **5/8-by-1-1/2-inch (16-by-38-mm)** steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than **10 inches (250 mm)** o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
- B. Provide steel strap anchors, **1/8 by 2 inches (3 by 50 mm)**, with a minimum **6-inch (150-mm)** embedment and **2-inch (50-mm)** hook, unless otherwise indicated, for securing door frames into adjoining concrete or masonry. Weld anchors to frame jambs no more than **12 inches (300 mm)** from both bottom and head of frame, and space anchors not more than **30 inches (750 mm)** apart.
- C. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.
- D. Galvanize frames in the following locations:
  - 1. Exterior.

## 2.12 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 80 steel pipe.
  - 1. Cap bollards with **1/4-inch- (6-mm-)** minimum steel plate.

## 2.13 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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- B. Finish metal fabrications after assembly.

## 2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
  - 1. ASTM A 123, for galvanizing steel and iron products.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

### 3.2 SETTING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

### 3.4 INSTALLING PIPE BOLLARDS

- A. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.
- B. Fill bollards solidly with concrete.
  - 1. Do not fill removable bollards with concrete.

### 3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500